299H Series Pressure Reducing Regulators

WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

Fisher® regulators must be installed, operated and maintained in accordance with federal, state and local codes, rules and regulations and Emerson Process Management Regulator Technologies, Inc. (Regulator Technologies) instructions.

If the regulator vents gas or a leak develops in the system, service to the unit may be required. Failure to correct trouble could result in a hazardous condition.

Call a gas service person to service the unit. Only a qualified person must install or service the regulator.

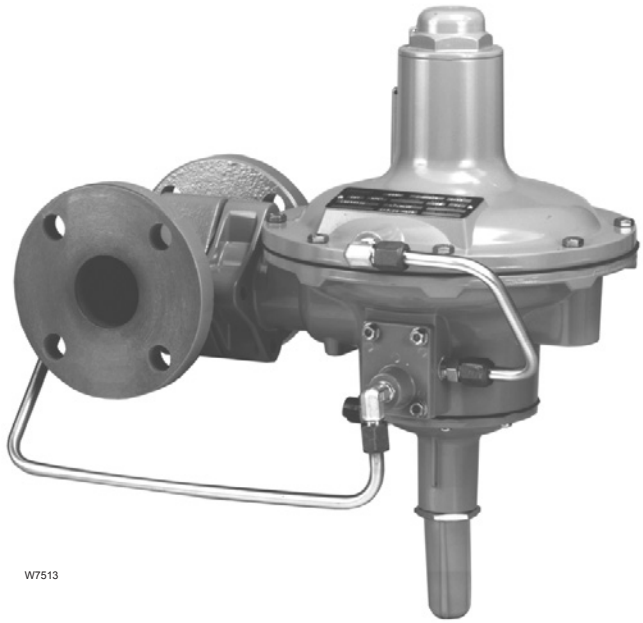

Figure 1. *299H Series Pressure Reducing Regulator*

Introduction

Scope of the Manual

This Instruction Manual provides installation, adjustment and maintenance instructions and parts ordering information for the 299H Series regulators. Complete instructions and parts list for the 67C Series filtered pilot supply regulator and other Fisher equipment are found in separate instruction manuals.

Description

The 299H Series pressure reducing regulators provide a broad capacity of controlled pressure ranges and capacities in a wide variety of distribution, industrial and commercial applications. A 299H Series regulator has a pilot integrally mounted to the actuator casing. The 299H Series regulators can handle inlet pressures up to 175 psi / 12.1 bar depending on orifice size.

The integral token relief on the Types 299HR and 299HSR regulators is located in the pilot and opens to relieve minor overpressure.

The Type 299HS provides overpressure or overpressure and underpressure protection by completely shutting off the flow of gas to the downstream system. It comes with a Type VSX-2 slam-shut device which can be configured for Ovepressure Shutoff (OPSO) or Overpressure and Underpressure Shutoff (OPSO/UPSO). The slam-shut device's actions are independent of the main valve and of variations to the inlet pressure. The Type VSX-2 slam-shut device has internal or external registration. External registration requires a downstream sensing line.

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Specifications

Specifications for 299H Series constructions are given below. Some specifications for a given regulator as it originally comes from the factory are stamped on a nameplate located on the actuator upper casing.

Available Constructions

Type 299H: Pilot-operated pressure reducing regulator with a pilot integrally mounted to the actuator casing.

Type 299HR: A Type 299H with a token internal relief valve to relieve minor overpressure caused by thermal expansion.

Type 299HS: Same as the Type 299H with a Type VSX-2 slam-shut valve which provides overpressure or overpressure and underpressure protection.

Type 299HSR: Same as the Type 299HS with an internal token relief valve.

Body Size and End Connection Styles

See Table 1

Maximum Operating Inlet Pressure by Orifice Size(1)

1/4 x 3/8-inch / 6.4 x 9.5 mm..... 175 psig / 12.1 bar
3/8 inch / 9.5 mm ..... 175 psig / 12.1 bar
1/2 inch / 13 mm ..... 175 psig / 12.1 bar
3/4 inch / 19 mm ..... 150 psig / 10.3 bar
7/8 inch / 22 mm(5)..... 125 psig / 8.6 bar
1 inch / 25 mm(5).....100 psig / 6.9 bar
1-3/16 inches / 30 mm(5) ..... 80 psig / 5.5 bar

Maximum Casing and Emergency Outlet Pressure(1)

66 psig / 4.5 bar

Outlet (Control) Pressure Ranges(1)(2)

See Table 2

Maximum Set Pressure for Type 299HS(1)

16 psig / 1.1 bar

Maximum Set Pressure for Slam-Shut Device(1)

23 psig / 1.6 bar

Minimum and Maximum Trip Pressure Ranges

See Table 3

Type VSX-2 Sensing Line Connection

1/4 NPT

Pressure Control Accuracy (Fixed Factor)(PFM)

±1%(3) of absolute control pressure

Minimum Differential Pressure For Full Stroke

1.5 psid / 0.10 bar d

Control Line Connections

3/4 NPT

Temperature Capabilities(1)

-20 to 150°F / -29 to 66°C

Approximate Weight

21 pounds / 10 kg

Pressure Registration

Internal, External or Dual Registration
See Figure 2

Fixed Restriction Sizes

0.044 inch / 1.1 mm, Red (**standard** gain)
0.071 inch / 1.8 mm, Green (low gain)
0.082 inch / 2.1 mm, Blue (lower gain)

Options

- **Filter(3):** A P590 Series filter installed in the pilot supply tubing between main body and pilot
- **Filtered pilot supply regulator(3)(4):** A Type 67CF supply regulator with integral 5 micron Polyethylene filter

1. The pressure/temperature limits in this Instruction Manual and any applicable standard or code limitation should not be exceeded.
2. For optimum performance, a pilot supply regulator may be installed in the pilot supply tubing between the main valve and pilot.
3. A pilot supply regulator or a P590 Series filter (only one may be used, not both) may be ordered with the Type 299H, but not both.
4. For inches w.c., use a pilot supply regulator if actual inlet pressure varies more than ±20 psi / ±1.4 bar and published accuracy is required.
5. This orifice size is not available for Types 299HS and 299HSR.

Table 1. *Body Sizes and End Connection Styles*

BODY SIZE, INCH / DN	BODY MATERIAL AND END CONNECTION STYLE		
	Cast Iron (For Types 299H and 299HR only)	Ductile Iron	Steel (For Types 299H and 299HR only)
1-1/4 1-1/2	NPT NPT	- - - - NPT	- - - - NPT
2 / 50	NPT and CL125 FF(1) flanged	NPT, CL125 FF and CL250 RF flanged and PN 10/16 flanged	NPT and CL150 RF flanged

1. This flange is available with a face-to-face dimension of 7.5 inches / 190 mm or 10 inches / 254 mm.

Table 2. *Outlet Pressure Ranges*

OUTLET (CONTROL) PRESSURE RANGE		TYPE		PILOT CONTROL SPRING					
		299H	299HR, 299HS and 299HSR	Part Number	Color	Free Length		Wire Diameter	
Inch w.c.	mbar					Inch	mm	Inch	mm
3.5 to 6[1]	9 to 15[1]	X	X	T13707T0012	Black	1.86	47.2	0.055	1.40
5 to 9[1]	12 to 22[1]	X	X	T13589T0012	Yellow	2.05	52.1	0.051	1.30
7 to 20[1]	17 to 50[1]	X	X	1N3112X0012	Unpainted	2.18	55.4	0.075	1.90
16 to 40[1]	40 to 99[1]	X	X	1B413727222	Purple	2.12	53.8	0.092	2.34
1 to 3.25 psig	69 mbar to 0.22 bar	X	X	T13593T0012	Light blue	2.12	53.8	0.105	2.67
2.75 to 6 psig	0.19 to 0.41 bar	X	X	T13671T0012	Orange	2.40	61.0	0.120	3.05
5 to 16 psig	0.34 to 1.1 bar	X	X	T13600T0012	Red	2.10	53.3	0.142	3.61
14 to 35 psig	0.97 to 2.4 bar	X	- - - -	19B0432X012	Zinc	2.15	54.6	0.207	5.26
30 to 60 psig	2.1 to 4.1 bar	X	- - - -	19B0432X022	Green	2.75	69.8	0.225	5.71

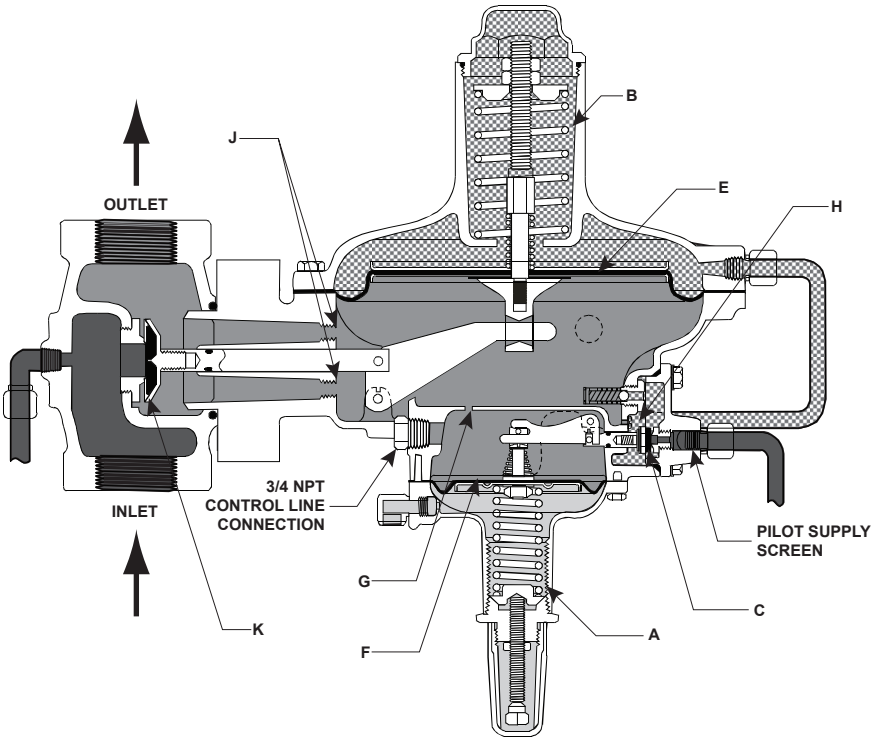
1. Use a pilot supply regulator if actual inlet pressure varies more than ±20 psi / ±1.4 bar and the published accuracy is required.

Table 3. *Type VSX-2 High and Low Trip Pressure Ranges*

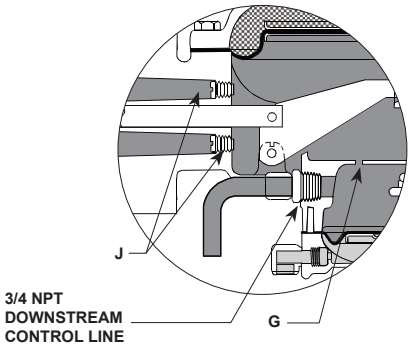
RANGE	SLAM-SHUT REGISTRATION	FOR USE WITH MAIN VALVE SPRING RANGE		MINIMUM TO MAXIMUM TRIP PRESSURE		TYPE VSX-2 SPRING PART NUMBER	SPRING FREE LENGTH		SPRING WIRE DIAMETER	
		Inch w.c.	mbar	Inch w.c.	mbar		Inch	mm	Inch	mm
High Pressure Trip	Internal or External	3.5 to 6	9 to 15	12 to 25	30 to 62	T14162T0012	3.15	80.0	0.07	1.70
		5 to 9	12 to 22							
		3.5 to 6	9 to 15	20 to 52	50 to 129	T14163T0012	3.15	80.0	0.08	2.03
		5 to 9	12 to 22							
		7 to 20	17 to 50							
		7 to 20	17 to 50	1.4 to 3.9 psig	97 to 269	T14164T0012	3.15	80.0	0.09	2.31
		16 to 40	40 to 99							
		16 to 40	40 to 99	3.8 to 8.7 psig	262 to 600	T14165T0012	3.15	80.0	0.12	3.05
		1 to 3.25 psig	69 mbar to 0.22 bar							
		2.75 to 6 psig	0.19 to 0.41 bar							
		2.75 to 6 psig	0.19 to 0.41 bar	5.8 to 16 psig	400 to 1103	T14166T0012	3.15	80.0	0.14	3.51
		5 to 16 psig	0.35 to 1.1 bar							
		5 to 16 psig	0.35 to 1.1 bar	11.6 to 23 psig	800 to 1586	T14167T0012	3.15	80.0	0.17	4.32
Low Pressure Trip	External	5 to 9	12 to 22	2 to 12	5 to 30	T14168T0012	3.15	80.0	0.04	1.09
		7 to 20	17 to 50							
		7 to 20	17 to 50	4 to 30	10 to 75	T14169T0012	3.15	80.0	0.06	1.40
		16 to 40	40 to 99							
		1 to 3.25 psig	69 mbar to 0.22 bar	0.36 to 2.3 psig	25 to 159	T14170T0012	3.15	80.0	0.07	1.70
		2.75 to 6 psig	0.19 to 0.41 bar							
		2.75 to 6 psig	0.19 to 0.41 bar	1.5 to 10.8 psig	103 to 745	T14171T0012	3.15	80.0	0.13	3.17
		5 to 16 psig	0.35 to 1.1 bar							
	Internal	5 to 9[1]	12 to 22[1]	- - - -	- - - -	- - - - - - - - - - -	- - - -	- - - -	- - - -	- - - -
		7 to 20[1]	17 to 50[1]							
		16 to 40[1]	40 to 99[1]							
		1 to 3.25 psig[2]	69 mbar to 0.22 bar[2]	70% of regulator setpoint to 2.3 psig	70% of regulator setpoint to 159 mbar	T14170T0012	3.15	80.0	0.07	1.70
		2.75 to 6 psig[2]	0.19 to 0.41 bar[2]							
		2.75 to 6 psig[2]	0.19 to 0.41 bar[2]	70% of regulator setpoint to 10.8 psig	70% of regulator setpoint to 745 mbar	T14171T0012	3.15	80.0	0.13	3.17
		5 to 16 psig[3]	0.35 to 1.1 bar[3]	75% of regulator setpoint to 10.8 psig	75% of regulator setpoint to 745 mbar	T14171T0012	3.15	80.0	0.13	3.17

1. Low Pressure Trip cannot be used with this main valve spring range for an internally registered Type VSX-2 to provide underpressure shutoff under flowing conditions. If protection against loss of inlet pressure is the only required function for the Type VSX-2 then an internally registered Type VSX-2 may be used with the same minimum trip pressures as an externally registered Type VSX-2.
2. 70% of regulator setpoint is the minimum allowable Low Pressure Trip setting for an internally registered Type VSX-2 used with this main valve spring range. If protection against loss of inlet pressure is the only required function for the Type VSX-2 then an internally registered Type VSX-2 may be used with the same minimum trip pressures as an externally registered Type VSX-2.
3. 75% of regulator setpoint is the minimum allowable Low Pressure Trip setting for an internally registered Type VSX-2 used with this main valve spring range. If protection against loss of inlet pressure is the only required function for the Type VSX-2 then an internally registered Type VSX-2 may be used with the same minimum trip pressures as an externally registered Type VSX-2.

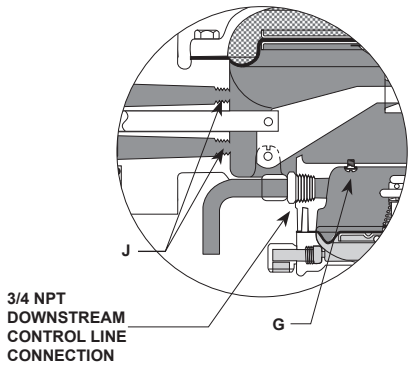
Note: Other spring combinations are available, please contact your local Sales Office for additional information.



INTERNAL REGISTRATION

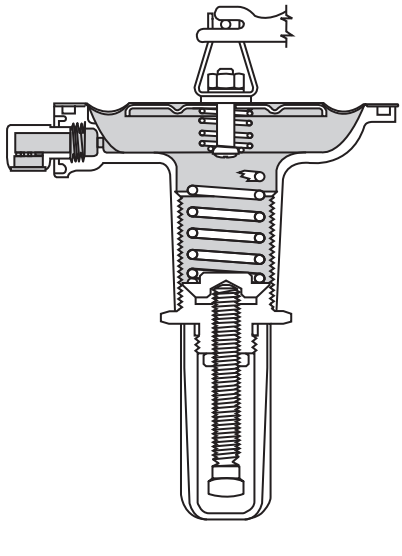


EXTERNAL REGISTRATION

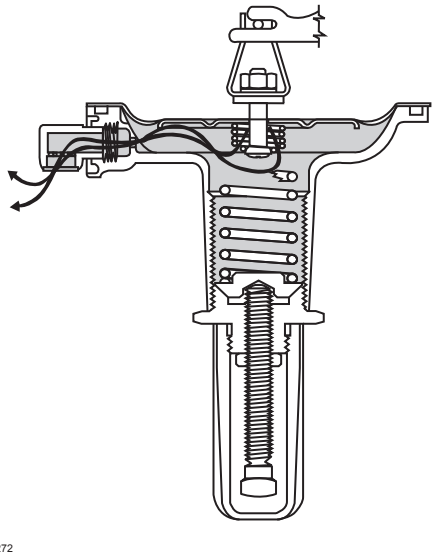


DUAL REGISTRATION

TYPE 299H



TOKEN RELIEF CLOSED



TOKEN RELIEF OPEN

TYPE 299HR (TOKEN RELIEF DETAIL)

Figure 2. *299H Series Operational Schematics*

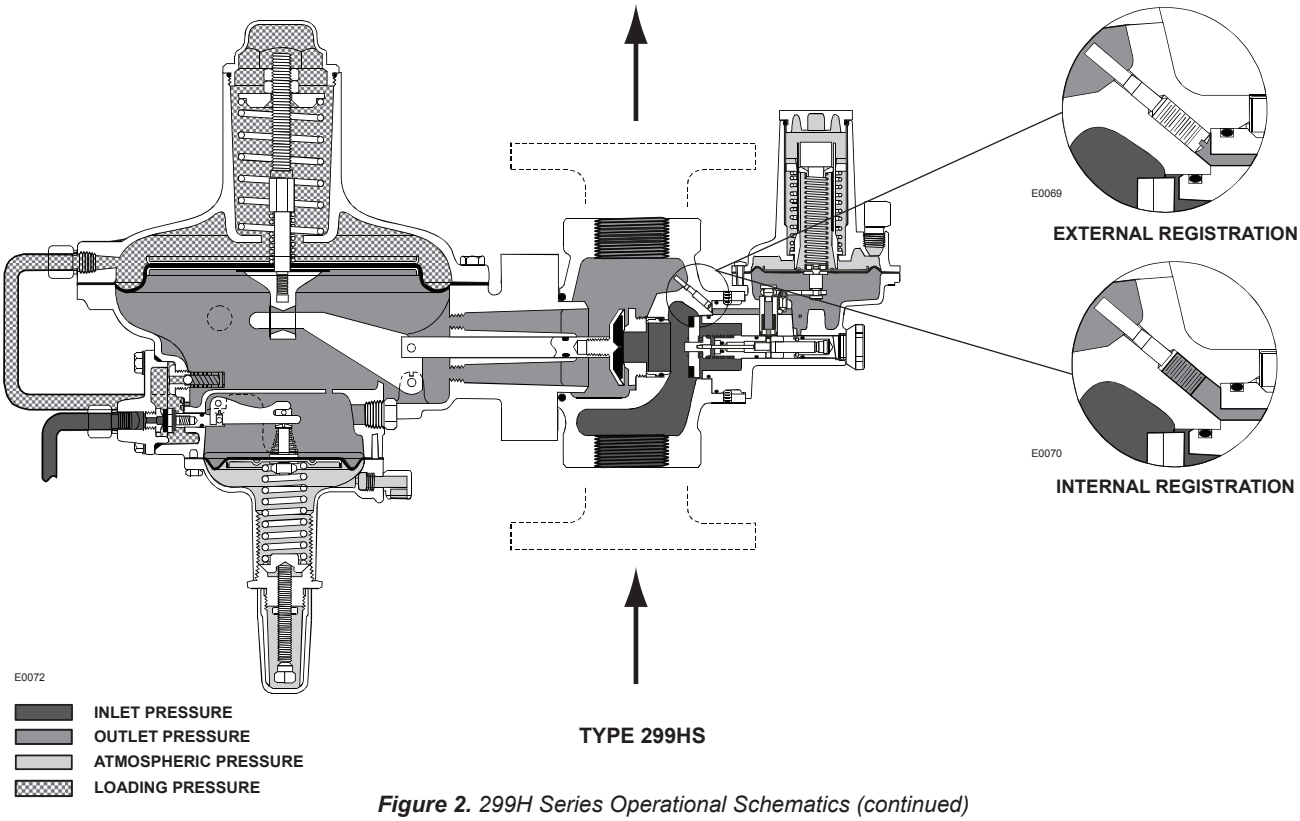


Figure 2. *299H Series Operational Schematics (continued)*

Principle of Operation

WARNING

Since a pilot-operated regulator is constructed of both a pilot and a main valve, do not exceed the maximum inlet pressure shown on the nameplate.

Letter keys in this section refer to Figure 2 unless otherwise noted. Fast response and accuracy are made possible by the amplifying effect of the pilot and by the two-path control system. The function of the pilot is to sense change in the controlled pressure and amplify it into a larger change in the loading pressure. Any changes in outlet pressure act quickly on both the actuator diaphragm and the loading pilot, thus providing the precise pressure control that is characteristic of a two-path control system.

Upstream or inlet pressure is utilized as the operating medium, which is reduced through pilot operation to load the main diaphragm chamber. Tubing connects the inlet pressure to the pilot. Downstream or outlet pressure registers underneath the main diaphragm (E) and on top of pilot diaphragm (F). There are three different versions of pressure registration for the 299H Series.

Internal registration—Outlet pressure is registered through the throat (J) to the main diaphragm chamber and then through a small port (G) to the top of the pilot diaphragm.

External registration—The throat (J) is blocked and a downstream control line is connected to the pilot upper diaphragm chamber or the actuator lower diaphragm chamber. A small port (G) connects the two chambers.

Dual registration—The lower main diaphragm chamber registers outlet pressure through the throat (J) and the upper pilot diaphragm chamber registers downstream pressure by using a downstream control line. The port (G) between the chambers is blocked.

Type 299H

In operation, assume the outlet pressure is less than the setting of the pilot control spring (A). The top side of pilot diaphragm assembly (F) will have a lower pressure than the setting of the control spring (A). The control spring (A) forces the diaphragm assembly upward, opening the pilot orifice (C). Additional loading pressure is supplied from the pilot orifice to the top side of the main diaphragm (E).

This creates a higher pressure on the top side of the main diaphragm (E) than on the bottom side, forcing the diaphragm downward. This motion is transmitted through a lever, which pulls the valve disk (K) open, allowing inlet pressure to flow through the valve.

When the demand in the downstream system has been satisfied, the outlet pressure increases. The increased pressure is transmitted through the downstream control line (for external or dual registration) or through the port (G) (for internal registration) and acts on top of the pilot diaphragm (F). This pressure exceeds the pilot spring setting and forces the diaphragm down, closing the orifice (C). The loading pressure acting on the main diaphragm (E) bleeds to the downstream system through a bleed restriction (H).

With a decrease in loading pressure on top of the main diaphragm (E), the main closing spring (B) exerts an upward force on the diaphragm post which is connected to the main diaphragm (E), pulling it upward. This moves the main valve disk (K) toward its seat, decreasing flow to the downstream system.

Type 299HR

During normal operation the Type 299HR performance is identical to the Type 299H. If an overpressure condition occurs, the pilot diaphragm head will separate from the pilot diaphragm post and travel until it contacts the pilot spring case. The movement of the diaphragm head creates a path and a token or small amount of gas will be released.

When the overpressure condition ceases, the pilot diaphragm head will return to the diaphragm post and the regulator will return to normal operation.

Type 299HS

The Type VSX-2 slam-shut device on the Type 299HS regulator is a fast acting slam-shut valve which provides overpressure or overpressure and underpressure protection by completely shutting off the flow of gas to the downstream system. The slam-shut module's actions are independent of the Type 299HS main regulator and of the variations to the inlet pressure. The Type VSX-2 has internal or external registration. External registration requires a downstream sensing line.

The slam-shut disk is held in the open position (reset position) by a small ball holding the disk stem. If the pressure below the diaphragm increases (or decreases) reaching the Type VSX-2 setpoint, the diaphragm will travel upwards (or downwards) operating a lever which in turn releases the ball.

Once the ball is released, the spring force on the stem will push the stem and disk to the closed position against the seat shutting off all gas flow. The pilot supply pressure is also shut off when the Type VSX-2 is closed. The manual reset has an internal bypass to equalize the reset pressure on either side on the slam-shut disk.

In order for the Underpressure Shutoff (UPSO) of any slam shut to be triggered, the downstream pipe pressure must drop below the UPSO setpoint. In the case of a downstream line break, numerous factors can prevent the downstream pipe pressure from decreasing below the slam-shut UPSO setpoint. These factors include the distance of pipe to the break, the diameter of the pipe, size of the break and the number of restrictions, such as valves, elbows and bends, downstream of the regulator and/or slam-shut device. Due to these factors additional protections should be installed to stop flow in the event of a line break.

Overpressure Protection

Like most regulators, the Type 299H has outlet pressure ratings lower than the inlet pressure ratings. Complete downstream overpressure protection is needed if the actual inlet pressure exceeds the outlet pressure rating.

Overpressure protection for internal parts is built into the main and pilot diaphragms by means of a small spring on each post. The springs will allow the diaphragm heads to move farther on the posts avoiding damage to or bending of the valve trim.

Overpressuring any portion of a regulator or associated equipment may cause leakage, parts damage or personal injury due to bursting of pressure-containing parts or explosion of accumulated gas. Regulator operation within ratings does not preclude the possibility of damage from external sources or from debris in the pipeline. A regulator should be inspected for damage periodically and after any overpressure condition.

The pilot vent is provided with a 1/4 NPT tapped connection in the spring case.

Installation

WARNING

Personal injury, equipment damage or leakage due to escaping gas or bursting of pressure-containing parts might result

if this regulator is overpressured or is installed where service conditions could exceed the limits for which the regulator was designed or where conditions exceed any ratings of the adjacent piping or piping connections. To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by the appropriate code, regulation or standard) to prevent service conditions from exceeding those limits.

A regulator may vent some gas to the atmosphere in hazardous or flammable gas service. Vented gas might accumulate and cause personal injury, death or property damage due to fire or explosion. Vent a regulator in hazardous gas service to a remote, safe location away from air intakes or any hazardous location. Protect the vent line or stack opening against condensation or clogging.

If the regulator is exposed to an overpressure condition, it should be inspected for any damage that may have occurred. Operation below these limits does not preclude the possibility of damage from external sources or from debris in the pipeline.

If the Type VSX-2 is exposed to an overpressure condition, it should be inspected for any damage that may have occurred. Operation below these limits does not preclude the possibility of damage from external sources or from debris in the pipeline.

In the case of a downstream line break, numerous factors affect the capability to evacuate gas from the pipeline. These factors include the distance of pipe to the break, the diameter of the pipe, size of the break and the number of restrictions, such as valves, elbows and bends, downstream of the regulator and/or slam-shut device. Due to these factors additional protections should be installed to stop flow in the event of a line break.

Like most regulators, the 299H Series regulators have an outlet pressure rating lower than its inlet pressure rating. Complete downstream overpressure protection is needed if the actual inlet pressure can exceed the regulator outlet pressure rating or the pressure ratings of any downstream equipment. Regulator operation within ratings does not preclude the possibility of damage from external sources or from debris in the lines. A regulator should be inspected for damage periodically and after any overpressure condition.

Clean out all pipelines before installation. Check for damage which might have occurred during shipment. Also, check for and remove any dirt or foreign material which may have accumulated in the regulator body.

Apply pipe compound to the external pipe threads of threaded bodies or use suitable line gaskets and good bolting practices with a flanged body. This regulator may be installed in any position desired as long as the flow through the body is in the direction indicated by the arrow on the body. Install a three-valve bypass around the regulator if continuous operation is necessary during maintenance or inspection.

Although the standard orientation of the actuator and pilot to the main valve body is as shown in Figure 1, this orientation may be changed in 90° intervals by rotating the actuator lower casing (key 1, Figure 6) and the elbow fitting (key 19) by 90° and then reinstalling the cap screws.

To keep the pilot spring case from being plugged or the spring case from collecting moisture, corrosive chemicals or other foreign material, the vent must be pointed down oriented to the lowest possible point on the spring case or otherwise protected. Vent orientation may be changed by rotating the pilot spring case with respect to the pilot body.

To remotely vent the pilot, remove the screwed-in vent assembly (key 27, Figure 5) from the pilot spring case and install obstruction-free tubing or piping into the 1/4 NPT vent tapping. Provide protection on a remote vent by installing a screened vent cap into the remote end of the vent pipe.

An upstream pilot supply line is not required because of the integral pilot supply tubing (key 21, Figure 6). However, as long as the 1/4 NPT tapping in the main valve body is plugged, this tubing may be disconnected from the main valve (key 17) in order to install a pilot supply line from a desired remote location into the pilot.

If using a control line, attach the control line from the pilot tap 2 to 3 feet / 0.61 to 0.91 meters downstream of the regulator in a straight run of pipe. If impossible to comply with this recommendation due to the pipe arrangement, it may be better to make the control line tap nearer the regulator outlet rather than downstream of a block valve. Do not make the tap near any elbow, swage or nipple which might cause turbulence. For optimal performance, use as large of a control line as practical.

In many instances, it will be necessary to enlarge the downstream piping to keep flow velocities within good engineering practices. Expand the piping as close to the regulator outlet as possible.

WARNING

Adjustment of the pilot control spring to produce an outlet pressure higher than the upper limit of the outlet pressure range for that particular spring can cause personal injury or equipment damage due to bursting of pressure-containing parts or the dangerous accumulation of gases if the maximum actuator emergency casing pressure is exceeded. If the desired outlet pressure is not within the range of the pilot control spring, install a spring of the proper range according to the Maintenance section.

Each regulator is factory-set for the pressure setting specified on the order. If no setting was specified, the outlet pressure is set midrange of the pilot control spring. In all cases, check the control spring setting to make sure it is correct for the application.

Registration Conversion

To convert the 299H Series regulators from one type of registration to another, all that is required is adding or removing screws and O-rings.

To change an internal registration regulator to an external registration regulator with a downstream control line, block the two ports in the throat with screws and O-rings (J in Figure 2). Remove either the 3/4 NPT pipe plug in the pilot casing or the 3/4 NPT pipe plug in the lower casing and add a downstream control line.

To convert an external registration regulator to a dual registration regulator, remove the two screws and O-rings (J in Figure 2) from the throat and use a screw and an O-ring to block the port (G in Figure 2) between the lower diaphragm chamber and pilot diaphragm chamber. Remove the 3/4 NPT pipe plug in the pilot lower casing and add a downstream control line.

Type VSX-2 Slam-Shut Device

To convert the Type VSX-2 from one type of registration to another, all that is required is adding or removing a screw and gasket.

To change an internal registration Type VSX-2 to an external registration Type VSX-2 with downstream control line, block the body pitot tube with a screw and gasket (keys 10 and 11, Figure 7). Remove the pipe plug in the Type VSX-2 and add a downstream control line.

Type VSX-2 Installation

Note

The Type VSX-2 slam-shut module should be mounted so that the spring case vent points towards the ground.

Keys are referenced in Figure 7. Place new O-rings (keys 2 and 3) on the Type VSX-2 and slide the module into the Type 299HS body (key 17). Secure the Type VSX-2 to the Type 299HS body with the four set screws (key 4). The Type VSX-2 device may be oriented in any direction with respect to the sensor line connection.

Startup

With proper installation completed and downstream equipment properly adjusted, perform the following procedure while monitoring the pressure with gauges.

1. Very slowly open the upstream block valve.
2. On a Type 299HS, the Type VSX-2 is shipped in the tripped position and will need to be reset. If the Type VSX-2 is a high trip only, it can be reset before starting the regulator. If the Type VSX-2 is a high and low trip, the regulator will need to be started and the downstream system pressurized before the Type VSX-2 can be reset. See the section for Type VSX-2 reset.
3. Slowly open the hand valve (if used) in the control line. The regulator will control downstream pressure at the pilot control spring setting. See the Adjustment section following these numbered steps if changes in the setting are necessary during the start-up procedure.
4. Slowly open the downstream block valve.
5. Slowly close the bypass valve, if used.
6. Check all connections for leaks.

Adjustment

Keys are referenced in Figure 4. The only adjustment on a 299H Series regulator is the reduced pressure setting of the pilot control spring (key 32). Remove the closing cap (key 29) and turn the adjusting screw

(key 36). Turning the adjusting screw clockwise into the spring case increases the controlled or reduced pressure setting. Turning the screw counterclockwise decreases the reduced pressure setting. Always tighten the locknut (key 35) and replace the closing cap after making adjustments.

Type VSX-2 Reset

Note

The overpressure and underpressure trip points can only be reset if the Type 299HS outlet pressure is between the overpressure and underpressure trip points.

Use the following procedure to reset the Type VSX-2:

1. Unscrew the brass resetting knob to open the equalizing bypass.
2. Pull out the knob until it stops. This resets the tripping mechanism.
3. Push in and tighten the knob.

Type VSX-2 Trip Adjustment

Note

An adjustment tool is included with the Type VSX-2 (see Figure 8). Use only this tool to make adjustments to the Type VSX-2. To make adjustments, the overpressure trip spring (key 7, Figure 7) is found under the outer adjusting screw and the underpressure trip spring (key 8) is found under the inner adjusting screw.

Use the following procedure to adjust the Overpressure Trip Spring:

1. Use the Type VSX adjusting tool to adjust the overpressure trip spring to its maximum compression (see Figure 8).
2. If present, adjust the underpressure spring (using the Type VSX adjusting tool) to its minimum compression.
3. Backpressure the unit with the desired overpressure trip pressure.
4. Reduce the overpressure trip spring compression until the Type VSX-2 trips.

Use the following procedure to adjust the Underpressure Trip Spring:

1. Use the Type VSX adjusting tool to adjust the underpressure trip spring to its minimum compression.
2. Backpressure the unit with the desired underpressure trip pressure.
3. Increase the underpressure trip spring compression (using the Type VSX adjusting tool) until the Type VSX-2 trips.

Shutdown

Installation arrangements may vary, but in any installation it is important to open and close valves slowly and the outlet pressure be vented before venting inlet pressure to prevent damage caused by reverse pressurization of the regulator. Isolate the regulator from the system. Vent the downstream pressure; then vent inlet pressure to release any remaining pressure in the regulator.

Maintenance

Regulator parts are subject to normal wear and must be inspected periodically and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions and upon applicable codes and government regulations.

Due to the care Regulator Technologies takes in meeting all manufacturing requirements (heat treating, dimensional tolerances, etc.), use only replacement parts manufactured or furnished by Regulator Technologies.

WARNING

Avoid personal injury or damage to property from sudden release of pressure or uncontrolled gas or other process fluid. Before starting to disassemble, carefully release all pressures according to the Shutdown procedure. Use gauges to monitor inlet, loading and outlet pressures while releasing these pressures.

On reassembly of the regulator, it is recommended that a good quality pipe thread sealant be applied to pressure connections and fittings and a good quality lubricant be applied to all O-rings. Also apply an anti-seize compound to the adjusting screw threads and other areas as needed.

Note

The regulator body may remain in the pipeline during maintenance procedures.

Main Actuator Diaphragm

Follow this procedure to change the actuator diaphragm or to inspect, clean or replace any other parts in the main actuator. Part key numbers are referenced in Figures 5 and 6.

1. Cut the wire seal (key 68) (being careful not to lose the warning tag) and remove the closing cap (key 3). Inspect the O-ring (key 9) and replace if necessary.
2. Carefully loosen and remove the double nuts (key 5) on the actuator diaphragm post (key 10). When removing the adjusting nuts, do not twist or unscrew the diaphragm post, as this action will loosen the joint between the diaphragm post and the pusher post (keys 10 and 11).
3. Remove the spring seat (key 4) and closing spring (key 6).
4. Remove the eight hex head cap screws (key 23) and lift off the upper casing (key 2).
5. Remove the diaphragm assembly (key 8) by tipping it so that the lever (key 26) slips out of the pusher post (key 11).
6. Separate the diaphragm assembly by unscrewing the diaphragm post (key 10) from the pusher post (key 11) and remove the diaphragm post, pressure equalization spring (key 7), diaphragm head (key 81), diaphragm (key 8), the second diaphragm head (key 81) and diaphragm pad (key 80). Inspect the diaphragm parts for damage and replace if necessary.
7. Inspect the lever (key 26) and replace if necessary. To replace the valve stem (key 16), also perform Main Body Valve Disk and Orifice maintenance procedure steps 1, 2 and 3, remove disk (key 13) and pull the stem out of the lower casing assembly (key 1). Lightly lubricate the replacement stem O-ring (key 14) and install it on the valve stem. Reinstall the valve stem into the lower casing assembly. Reinstall the body (key 17) or continue with the reassembly of the diaphragm.

Note

When assembling the diaphragm assembly (keys 8, 80 and 81), lubricate the actuator diaphragm post (key 10) threads.

8. Loosely reassemble the diaphragm and diaphragm post parts so that the bolt holes in the diaphragm align with the corresponding holes in the lower casing (key 1) when the lever (key 26) is fitted properly into the pusher post. When this orientation is made, tighten the diaphragm post into the pusher post (keys 10 and 11).
9. Reinstall the diaphragm assembly using the reverse order of step 5.
10. Install the upper casing (key 2) and secure it to the lower casing (key 1) with the eight hex head screws (key 23). Tighten the hex head screws evenly using a crisscross pattern to avoid placing an uneven strain on the regulator. Tighten the screws to a final bolt torque of 10 to 13 foot-pounds / 13 to 17 N•m to avoid crushing the diaphragm.

CAUTION

In step 11, the spring seat (key 4) is under spring pressure. Use constant hand pressure to hold the spring down when installing the hex nuts (key 5), see Figure 5.

11. Install the closing spring (key 6) and the spring seat (key 4). Push and hold down on the spring seat, cocking it to one side until the seat catches onto the threads of the diaphragm post (key 10). Then, pull up on the diaphragm post allowing access to the post threads so that the two adjusting hex nuts (key 5) can be installed. Install the adjusting hex nuts as shown in Figure 5. The closing spring must be adjusted down to a depth of 1/2-inch / 13 mm from the top of the upper case opening to the top of the spring seat. When tightening the two hex nuts, use care not to rotate the diaphragm post, which may damage the post.
12. Lightly lubricate the O-ring (key 9) on the closing cap and reinstall the closing cap (key 3).

WARNING

The wire seal and warning tag (keys 68 and 69) contain important safety information, make sure they are attached when maintenance is completed.

13. Install the wire seal and warning tag (keys 68 and 69).

Main Body Valve Disk and Orifice

Follow this procedure to inspect, clean or replace the main body valve disk or to inspect or replace the orifice. Part key numbers are referenced in Figures 5 and 6.

Note

The regulator body may remain in the pipeline during maintenance procedures.

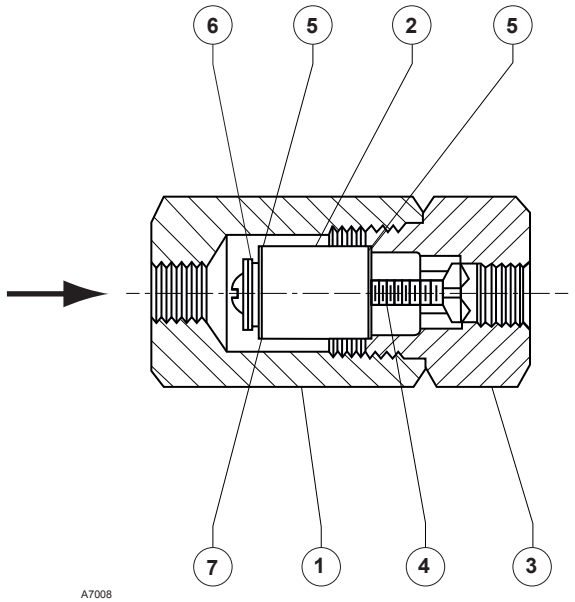
1. Disconnect the pilot supply tubing (key 21) from the main body (key 17).
2. Remove the two hex head cap screws (key 18) which hold the lower casing (key 1) to the body. Separate the lower casing from the body. Inspect the body O-ring (key 15) and replace if worn or damaged.
3. Examine the valve disk (key 13) and orifice (key 12) for nicks, cuts and other damage. Unscrew the disk holder assembly from the valve stem assembly (key 16) and replace it with a new part if necessary. For the Type 299HS, also examine the insert and O-ring (keys 82 and 83, Figure 7) for any damage. Replace if needed.

   If the orifice is being replaced with a new or differently sized orifice, change the nameplate (key 63) to state the new size and maximum inlet pressure. Lubricate the threads and flat face of the orifice with a good grade of anti-seize lubricant. Install the orifice using 100 to 120 foot-pounds / 136 to 163 N•m of torque.
4. After replacing all damaged parts, slide the entire assembly into the valve body (key 17) and secure with the two hex head cap screws (key 18).
5. Connect the pilot supply tubing (key 21), then refer to the Startup section for putting the regulator into operation.

Integral Pilot Valve Disk and Orifice

Follow this procedure to inspect, clean or replace the integral pilot valve disk or orifice. Part key numbers are referenced in Figures 5 and 6.

1. Remove or loosen the pilot supply tubing (key 21).
2. Remove the inlet fitting (key 47) and the four machine screws (key 46).
3. Examine the valve disk (key 52) for nicks, cuts and other damage. Unscrew the disk holder assembly from the valve stem (key 48) and replace if necessary.



KEY 72 - OPTIONAL P590 SERIES FILTER

Figure 3. *Optional P590 Series Filter*

4. If the seating edge of the orifice (key 50) is nicked or rough, use a thin-walled socket to remove the orifice from the inlet fitting (key 47). Install a new orifice and a lightly lubricated O-ring (key 49) when reassembling the regulator.
5. Inspect the check valve assembly (key 45) and the bleed restriction (key 70) for damage and replace if necessary.
6. The Type 299H has a wire inlet screen (key 51) in the pilot supply inlet fitting (key 47). If clogging is suspected in the pilot supply, remove the elbow fitting (key 19) and clean the wire screen.
7. Lightly lubricate the O-ring (key 54) on the inlet fitting (key 47) and reinstall using the four machine screws (key 46). Torque the machine screws to 30 to 40 inch-pounds / 3.4 to 4.5 N•m. Then install and tighten the pilot supply tubing.

Integral Pilot Control Spring and Diaphragm

Follow this procedure to change the pilot control spring or to inspect, clean or replace the diaphragm. Part key numbers are referenced in Figures 4, 5 and 6.

1. Remove the pilot closing cap (key 29) and loosen the hex lock nut (key 35). Turn the adjusting screw (key 36) counterclockwise to ease spring compression.
2. Unscrew the bonnet (key 34).

3. Remove the bonnet (key 34), spring seat (key 33) and control spring (key 32).
4. If only replacing the control spring (key 32), sparingly apply lubricant to the control spring seat (key 33) and reassemble in the reverse order.

Note

When replacing the control spring with a different spring range, be sure to delete the spring range appearing on the nameplate and indicate the new range.

5. Remove the machine screws (key 30) and spring case (key 31) from the lower casing (key 1).
6. Remove the diaphragm assembly (key 28) by tilting them so that the pusher post (key 40) slips off the lever (key 57). To separate the diaphragm from the attached parts, unscrew the hex nut (key 37) and separate the parts: washer (key 38), diaphragm post (key 39), pusher post (key 40), overtravel spring (key 41), machine screw (key 42), spring seat (key 88) (Types 299HR and 299HSR), rivet (key 43) and retaining ring (key 44).
7. To replace the lever assembly (key 57), remove the lever pin (key 25). To replace the valve stem (key 48), also perform Integral Pilot Valve Disk and Orifice maintenance procedure steps 1, 2 and 3 and pull the stem (key 48) out of the lower casing assembly (key 1). Lightly lubricate the replacement stem O-ring (key 53) and install it on the valve stem.
8. Install the valve stem (key 48) into the lower casing assembly (key 1). Be careful not to cut the O-ring (key 53) when sliding the valve stem into the lower casing.
9. Reinstall the diaphragm (key 28) assembly using the reverse order of step 6.
10. Place the spring case (key 31) on the lower casing (key 1) with the vent (key 27) oriented downwards to prevent clogging or entrance or moisture. Install the machine screws (key 30) and tighten in a crisscross pattern using 12 to 18 inch-pounds / 1.4 to 2.0 N•m of torque.
11. When all maintenance is complete, refer to the Startup section to put the regulator back into operation and adjust the pressure setting. Tighten the locknut (key 35) and install the closing cap (key 29).

Type VSX-2 Maintenance

Parts numbers are referenced in Figure 7. The Type VSX-2 device (key 1) is designed to be removed as a unit from the Type 299HS body (key 17) and be replaced as a complete unit. The only replaceable parts in the Type VSX-2 module are the O-rings (keys 2 and 3) and the high and low pressure springs (keys 7 and 8). The high and low pressure springs may be adjusted or replaced without removing the slam-shut device from the Type 299HS body.

Optional P590 Series Filter

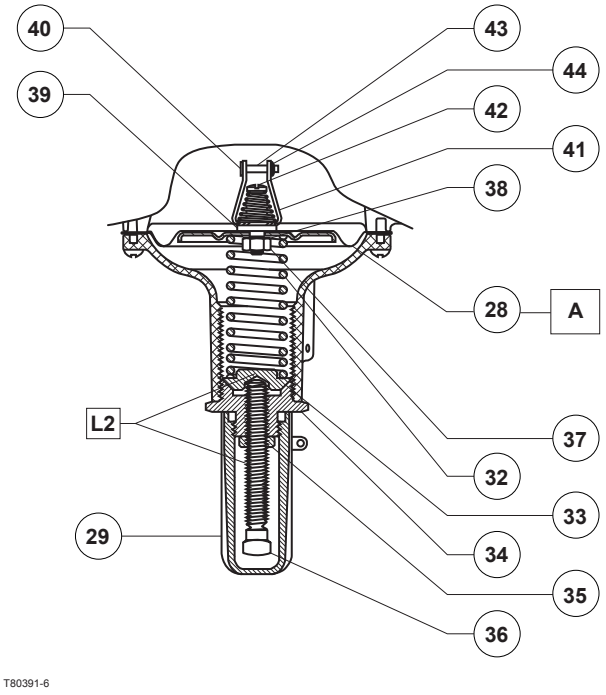
Keys are referenced in Figures 3 and 6. If clogging is suspected in the upstream regulator passages, disconnect the pilot supply tubing (key 21, Figure 6), remove the filter assembly (key 72) and check for filter clogging. If necessary, to clean or replace filter parts, remove the following: filter body (key 1), machine screw (key 4), spring washer (key 6), gasket (key 7), washer (key 5) and filter element (key 2). Upon reassembly, place one flat washer (key 5) between the filter element and filter head (key 3) and the other between the filter element and gasket.

Optional Type 67CF Pilot Supply Regulator

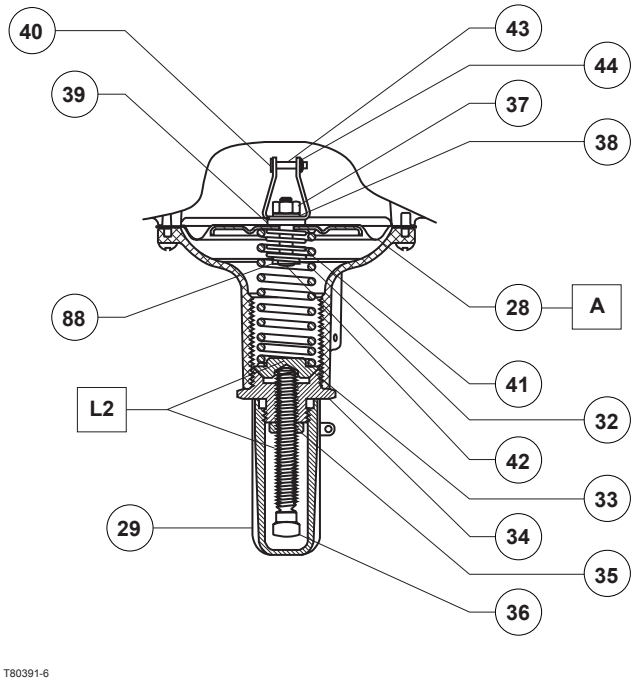
For complete installation, maintenance and parts list refer to the 67C Series Instruction Manual.

Parts Ordering

The type number, orifice size, spring range and date of manufacture are stamped on the nameplate. Provide this information along with the eleven-character part number to your local Sales Office when ordering parts. If construction changes are made in the field, be sure that the nameplate is also changed to reflect the most recent construction.



TYPE 299H PILOT WITHOUT RELIEF VALVE



TYPE 299HR PILOT WITH TOKEN RELIEF VALVE

☐ APPLY ANTI-SEIZE COMPOUND (L2) / ADHESIVE (A)

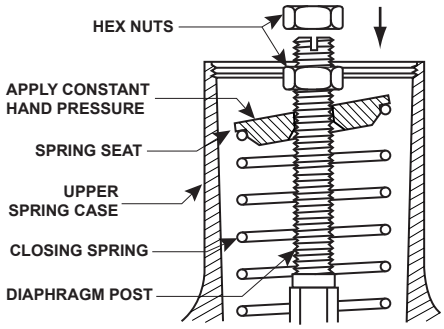
Figure 4. *299H Series Pilot Assemblies*

Parts List

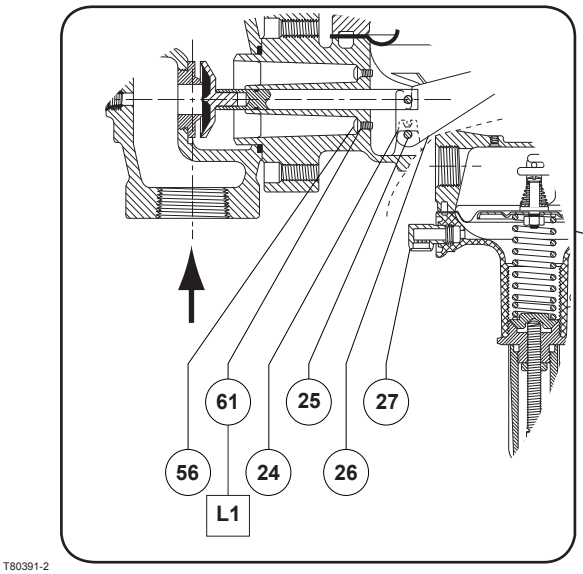
299H Series Regulator (Figures 4, 5 and 6)

Key	Description	Part Number
	Parts Kit (Includes keys 8, 9, 13, 14, 15, 28, 49, 52, 53, 54, 60, 61 and 80)	R299X000012
1	Lower Casing, Aluminum	T80447T0012
2	Upper Casing, Aluminum	T40577T0012
3	Closing Cap, Aluminum	1L928308012
4	Spring Seat, Steel	T13831T0012
5	Adjustment Nut, Steel (2 required)	1A341224122
6	Closing Spring, Steel	T13918T0012
7	Pressure Equalization Spring, Steel	T13463T0012
8*	Diaphragm, Nitrile (NBR)	T20986T0012
9*	O-ring, Nitrile (NBR)	1F914106992
10	Diaphragm Post, Steel	T13814T0012
11	Pusher Post, Aluminum	1L143311992
12	Orifice, Aluminum	
	1/4 x 3/8 inch / 6.4 x 9.5 mm	T13833T0012
	3/8 inch / 9.5 mm	1H979309022
	1/2 inch / 13 mm	1H979409022
	3/4 inch / 19 mm	1H979509022
	7/8 inch / 22 mm (for Types 299H and 299HR only)	T14098T0012
	1 inch / 25 mm (for Types 299H and 299HR only)	1H979609022
	1-3/16 inches / 30 mm (for Types 299H and 299HR only)	1H979709022
13*	Disk, Nitrile (NBR)	1P7349000A2
14*	O-ring, Nitrile (NBR)	1E216306992
15*	O-ring, Nitrile (NBR)	T12587T0012
16	Valve Stem Assembly	1L1426000A2
17	Valve Body	
	Cast Iron, For Types 299H and 299HR only	
	1-1/4 NPT	T40578T0012
	1-1/2 NPT	1J190419012
	2 NPT	1H968919012
	NPS 2 / DN 50	
	CL125 FF flanged	
	7.5-inch / 90 mm face-to-face dimension	T80445T0012
	10-inch / 254 mm face-to-face dimension	2L425119012
	Ductile Iron, For all 299H Series	
	1-1/2 NPT	T40561T0012
	2 NPT	T40562T0012
	NPS 2 / DN 50	
	CL125 FF flanged	T80424T0012
	CL250 RF flanged	T80425T0012
	PN 10/16 flanged	T80426T0012
	Steel, For Types 299H and 299HR only	
	1-1/2 NPT	1J1904T0022
	2 NPT	1H9689T0022
	NPS 2 / DN 50	
	CL150 RF flanged	T80415T0012
18	Cap Screw, Steel (2 required)	
	Types 299H and 299HR	T14034T0012
	Types 299HS and 299HSR	T14082T0012
19	Elbow (3 required for Cast Iron or Steel bodies; 2 required for Ductile Iron Bodies)	- - - - - - - - - - -
20	Connector(1)	- - - - - - - - - - -
21	Pilot Supply Tubing, Without filter	- - - - - - - - - - -
22	Loading Tubing	- - - - - - - - - - -
23	Cap Screw, Steel (8 required)	1C379124052

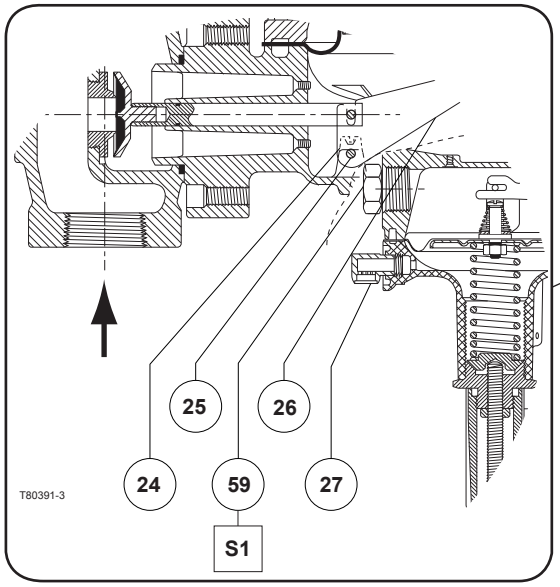
* Recommended spare part



LOCKING DOWN THE SPRING SEAT TO FACILITATE INSTALLING THE HEX NUTS



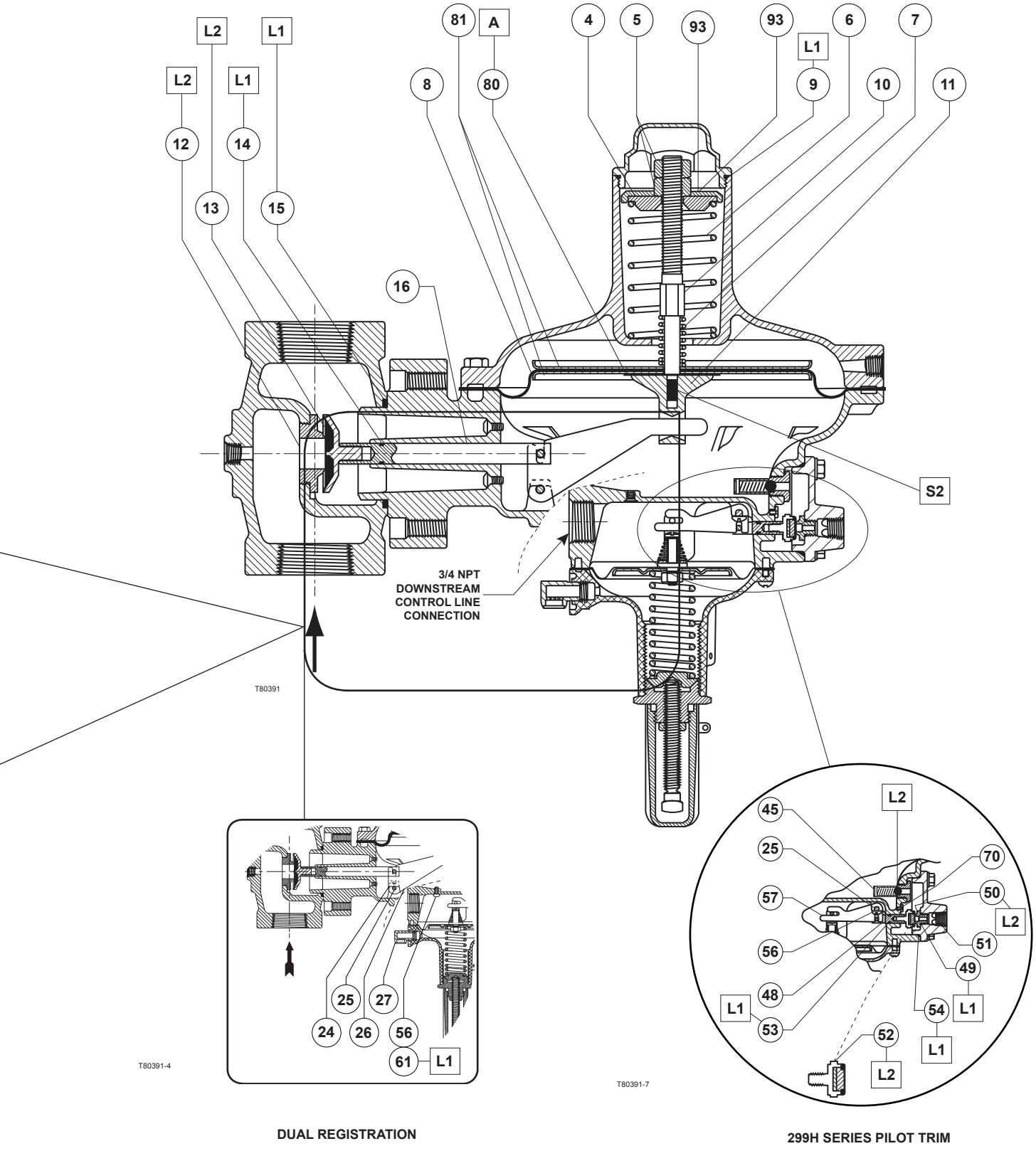
EXTERNAL REGISTRATION



INTERNAL REGISTRATION

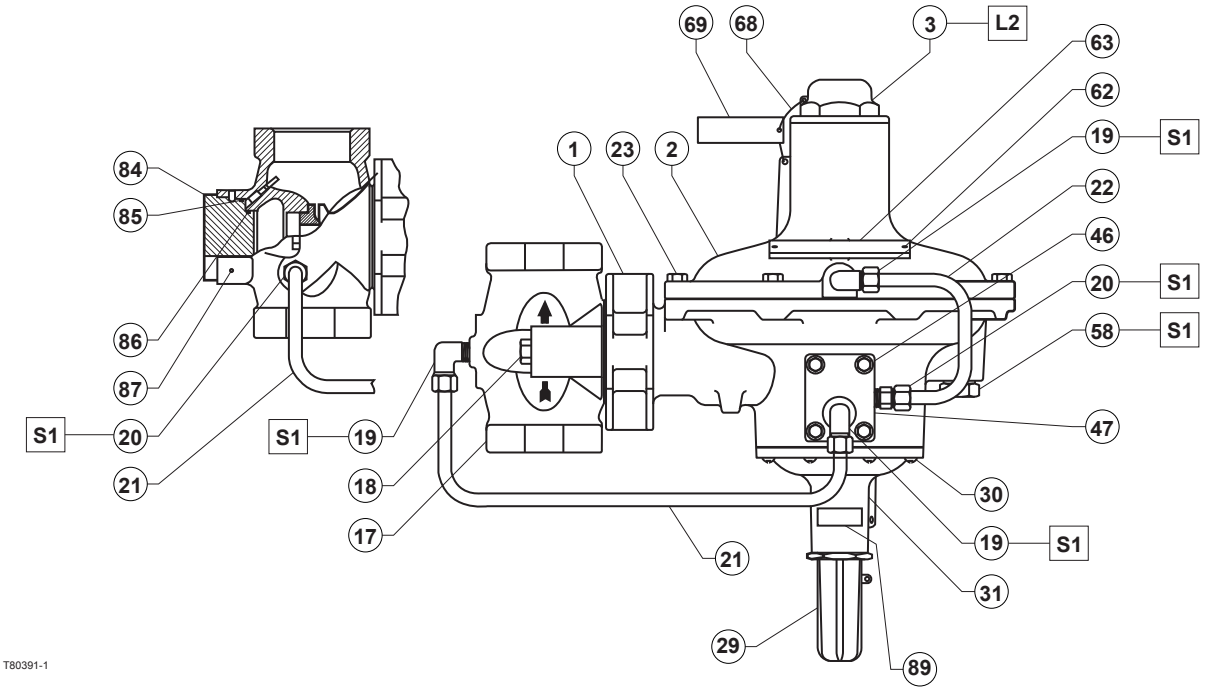
☐ **APPLY MULTI-PURPOSE LUBRICANT (L1) / MULTI-PURPOSE POLYTETRAFLUOROETHYLENE (PTFE) THREAD SEALANT (S1)**

Figure 5. *299H Series Interior Assembly*

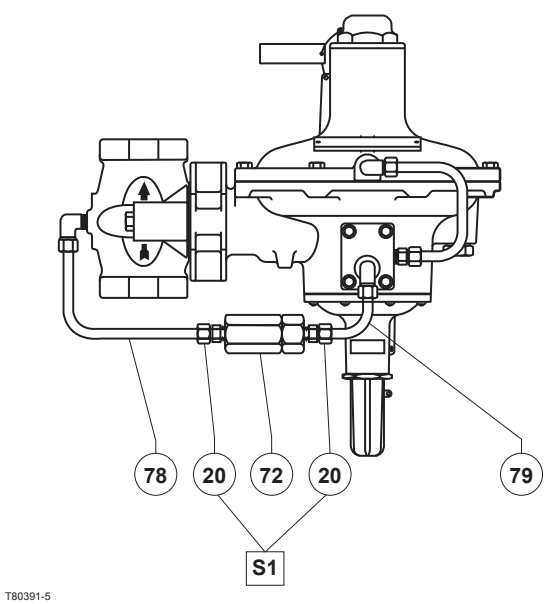


☐ APPLY MULTI-PURPOSE LUBRICANT (L1) / ANTI-SEIZE COMPOUND (L2) / THREAD LOCK SEALANT (S1) / ADHESIVE (A)

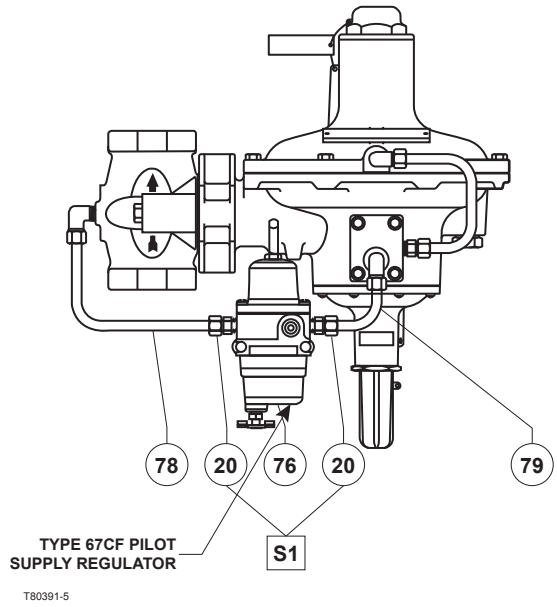
Figure 5. *299H Series Interior Assembly (continued)*



299H SERIES EXTERIOR VIEW



TUBING AND FITTINGS WITH OPTIONAL TYPE P590 FILTER



TUBING AND FITTINGS WITH OPTIONAL TYPE 67CF PILOT SUPPLY REGULATOR

☐ **APPLY ANTI-SEIZE COMPOUND (L2) / MULTI-PURPOSE PTFE THREAD SEALANT (S1).**

Figure 6. *299H Series Exterior Assembly*

Parts List (continued)

299H Series Regulator (Figures 4, 5 and 6) (continued)

Key	Description	Part Number
24	Machine Screw, Steel (2 required)	1B420428982
25	Lever Pin, Stainless steel (2 required)	1H972935032
26	Lever, Steel	T13813T0012
27	Vent Hood (Type Y602-12 Vent Assembly)	27A5516X012
28	Diaphragm Assembly, Nitrile (NBR) diaphragm and steel diaphragm head	T14259T0012
29	Closing Cap, Plastic	24B1301X012
30	Machine Screw, Steel (8 required)	T14069T0012
31	Spring Case, Aluminum	T14097T0012
32	Control Spring	See Table 2
33	Spring Seat, Steel	T13917T0012
34	Bonnet, Steel	T14135T0012
35	Locknut, Steel	1A352224122
36	Adjusting Screw, Steel	T14133T0012
37	Hex Nut, Steel	1E985324142
38	Washer, Steel	1F230328992
39	Diaphragm Post, Stainless steel	
	Types 299H and 299HS	T13915T0012
	Types 299HR and 299HSR	T14033T0012
40	Pusher Post, Steel	T13914T0012
41	Overtravel Spring, Stainless steel	
	Types 299H and 299HS	T14136T0012
	Types 299HR and 299HSR	T14031T0012
42	Machine Screw, Steel	1A954828992
43	Rivet, Flat head, Stainless steel	T13916T0012
44	Retaining Ring, Steel	16A6977X012
45	Check Valve Assembly	T14258T0012
46	Machine Screw, Steel (4 required)	T13920T0012
47	Inlet Fitting, Aluminum	T13824T0012
48	Stem Assembly, Aluminum	1H9666T0012
49*	O-ring, Nitrile (NBR)	T13939T0012
50	Pilot Orifice, Aluminum	T13825T0012
51	Inlet Screen, Stainless steel	T13791T0012
52*	Pilot Disk Assembly, Hydrogenated Nitrile (NBR) and Aluminum disk holder	T13955T0012
53*	O-ring, Nitrile (NBR)	1D682506992
54*	O-ring, Nitrile (NBR)	13A2331X022
56	Screw, Steel (External Registration - 2 required or Dual Registration - 1 required)	1E175828982
57	Lever, Steel	T14134T0012
58	Pipe Plug, Steel	1A7715T0012
59	Pipe Plug, Internal Registration only, Steel	
	3/4 NPT	1A7715T0012
	1/4 NPT	1A767524662
61	O-ring, Nitrile (NBR) (External Registration - 2 required or Dual Registration - 1 required)	17A0960X012
62	Drive Screw, Steel (2 required)	1E501728982
63	Nameplate, Aluminum	- - - - - - - - - -
68*	Wire Seal	T14088T0012
69	Warning Tag, Aluminum	- - - - - - - - - -
70	Bleed Restriction, Steel	
	0.044 inch / 1.1 mm, Red **(standard)**	17A2029X012
	0.071 inch / 1.8 mm, Green	17A2030X012
	0.082 inch / 2.1 mm, Blue	17A7277X012
72	Filter Assembly, See P590 Series	
	Type P593-1	AJ5004T0012
	Type P594-1	AJ5004000A2
78	Pilot Supply Tubing, Long (for constructions with filter or pilot supply option)	- - - - - - - - - -
79	Pilot Supply Tubing, Short (for constructions with filter or pilot supply option)	- - - - - - - - - -
80	Pad, Nitrile (NBR)	T13830T0012
81	Diaphragm Head, Steel (2 required)	T13812T0012
82	Insert (for Types 299HS and 299HSR only, see Figure 7) Aluminum[2]	T14013T0012
83	O-ring (for Types 299HS and 299HSR only, see Figure 7) Nitrile (NBR)[2]	T1072606562
84	Plate (for Types 299H and 299HR only), Steel[2]	T14039T0012
85	O-ring (for Types 299H and 299HR only), Nitrile (NBR)[2]	T13769T0012
86	O-ring (for Types 299H and 299HR only), Nitrile (NBR)[2]	T13772T0012
87	Set Screw (for Types 299H and 299HR only) (4 required)[2]	1C629828992
88	Spring Seat, Types 299HR and 299HSR	T14030T0012
89	Label, (not shown)	
	Types 299H and 299HS	T1215806032
	Types 299HR and 299HSR	T1215906032
92	Tee, Stainless steel	- - - - - - - - - -
93	Spring Seat Washer, Delrin®	19B0553X012
94	Plastic Plugs (not shown)	T13543T0042

Optional P590 Series Filter (Key 72, Figure 3)

Key	Description	Part Number
1	Filter Body	
	Type P594-1, Brass	1E312414012
	Type P593-1, Aluminum	1E3125X0022
2*	Filter Element, Cellulose	1E312606992
3	Filter Head	
	Type P594-1, Brass	1E312514012
	Type P593-1, Aluminum	1E3125X0022
4	Machine Screw	
	Type P594-1, Brass	1J500218992
	Type P593-1, Aluminum	1J500209012
5	Washer (2 required)	
	Type P594-1, Brass	1J500018992
	Type P593-1, Aluminum	1J500010062
6	Spring Washer, Plated carbon steel	1H885128982
7*	Gasket, Composition	1F826804022

Type VSX-2 Slam-Shut Device (Figure 7)

Key	Description	Part Number
1	Type VSX-2 Module	FA196247X12
2*	Upper O-ring, Nitrile (NBR)	T13769T0012
3*	Lower O-ring, Nitrile (NBR)	T13772T0012
4	Set Screw (4 required), Stainless steel	1C629828992
6	Type Y602-12 Vent Assembly	27A5516X012
7	High pressure Control Spring, Zinc-plated steel	
	12 to 25 inches w.c. / 30 to 62 mbar, Black	T14162T0012
	20 to 52 inches w.c. / 50 to 129 mbar, Brown	T14163T0012
	1.4 to 3.9 psig / 97 to 269 mbar, Red	T14164T0012
	3.8 to 8.7 psig / 262 to 600 mbar, Orange	T14165T0012
	5.8 to 16 psig / 400 to 1103 mbar, Pink	T14166T0012
	11.6 to 23 psig / 800 to 1586 mbar, Green	T14167T0012
8	Low pressure Control Spring, Zinc-plated steel	
	2 to 12 inches w.c. / 5 to 30 mbar, White	T14168T0012
	4 to 30 inches w.c. / 10 to 75 mbar, Blue	T14169T0012
	0.36 to 2.3 psig / 25 to 159 mbar, Unpainted	T14170T0012
	1.5 to 10.8 psig / 103 to 745 mbar, Olive	T14171T0012
10	Machine Screw (for external control line), Steel	1H8162X0012
11*	Gasket (for external control line), Nitrile (NBR)	T14191T0012
12	Adjustment Tool (see Figure 8)	FA142932X12
13	Pipe Plug (for internal registration), Steel, (not shown)	1A767524662

* Recommended spare part

1. Cast iron or steel bodies without filter and pilot supply regulator require 1 connector; all other combinations of filter and/or pilot supply regulator require 3 connectors. Ductile iron bodies without filter and pilot supply regulator require 2 connectors; all other combinations of filter and/or pilot supply regulator require 4 connectors.
2. Ductile iron bodies only.

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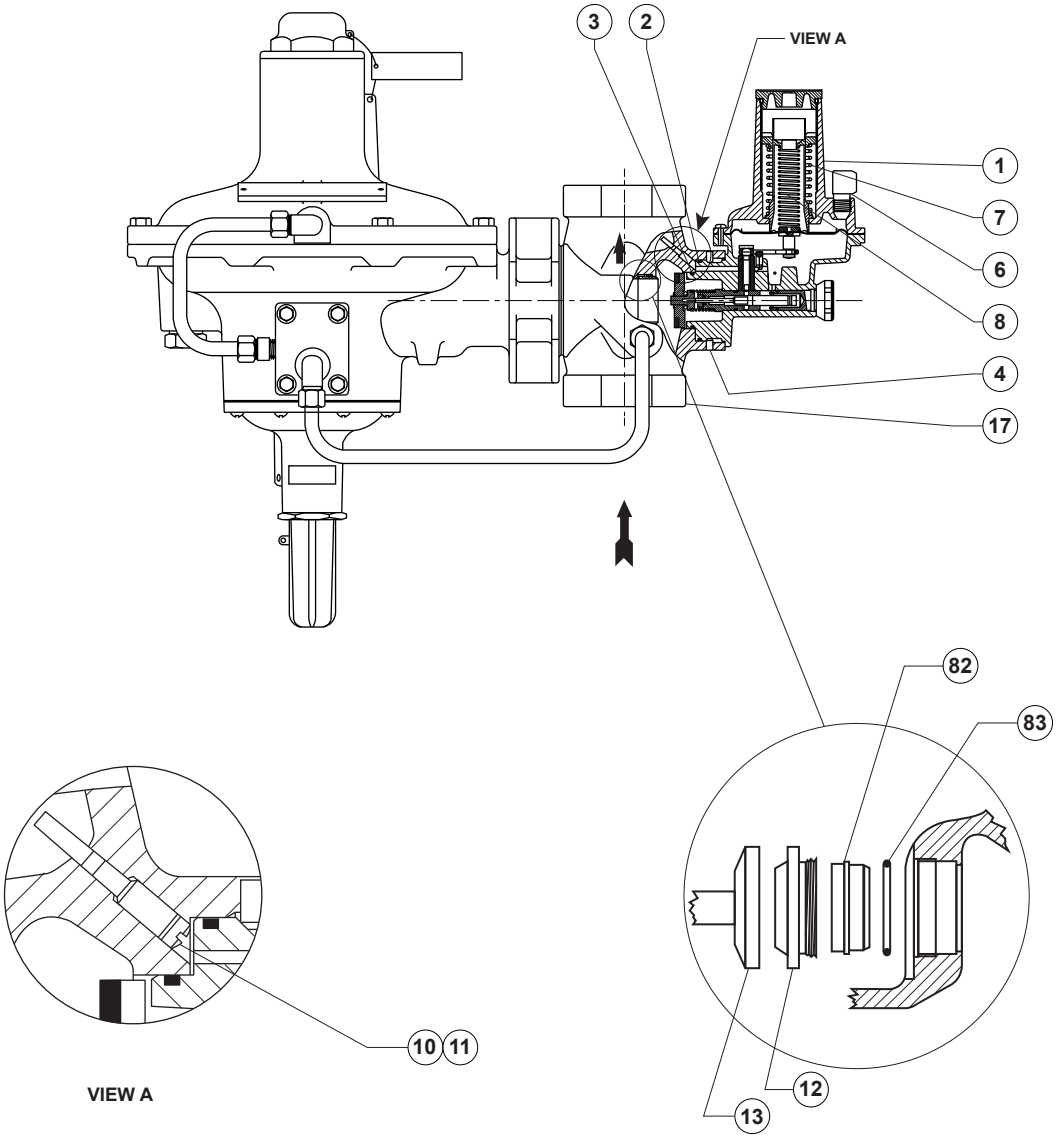

NOTE: FOR KEYS 12, 13, 17, 82 AND 83, REFER TO 299H SERIES REGULATORS PARTS LIST.

Figure 7. *Type VSX-2 Assembly (for Types 299HS and 299HSR)*

TYPE VSX ADJUSTING TOOL

TYPE VSX TOOL BEING USED TO ADJUST A TYPE VSX-2

Figure 8. *Type VSX Adjusting Tool*

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